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# Macrochelid Mites (Arachnida: Acari: Macrochelidae: *Glyptholaspis*, *Macrocheles*, *Neopodocinum*) Associated with Dung Beetles in Bali, Indonesia

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Ten species of mite of the family Macrochelidae (genera *Glyptholaspis*, *Macrocheles*, and *Neopodocinum*) are recorded from the body surface of dung beetles from Bali, Indonesia. Of those mites, two species, *Macrocheles baliensis* sp. nov. and *M. monticola* sp. nov., are described as new to science. *Neopodocinum spirostris* (Berlese, 1910) is redescribed on the basis of adults and immature stages collected from Bali. Seven species, *Glyptholaspis fimicola* (Sellnick, 1931), *Macrocheles hallidayi* Walter and Krantz, 1986, *M. krantzi* Evans and Hyatt, 1963, *M. merdarius* (Berlese, 1889), *M. oigru* Walter and Krantz, 1986, *Neopodocinum jaspersi* (Oudemans, 1900), and *N. spirostris* (Berlese, 1910), were recorded from Bali for the first time. *Macrocheles arabaesc* nom. nov. is proposed as a replacement name for *M. scarabae* Chinniah and Mohanasundaram, 1995 (preoccupied by *M. scarabae* Vishnupriya and Mohanasundaram, 1988).

**Key Words:** Macrochelidae, mites, Scarabaeidae, dung beetles, phoresy.

More than 400 species of macrochelid mite have been described from various regions of the world, and 25 species of the family Macrochelidae have been recorded from Southeast Asia to date. In Indonesia, 10 and 12 species have been recorded and described from Sumatra and Java, respectively (Oudemans 1903; Berlese 1905, 1910, 1911, 1921; Vitzthum 1925, 1931; Krantz 1965, 1967; Walter and Krantz 1986a, b; Takaku 1998, 2001). The macrochelid mite fauna of other islands of Indonesia is poorly known: only two species, *Macrocheles kraepelini* (Berlese, 1905) and *M. limue* Samšínák, 1962, have been collected from Sulawesi and Bali, respectively (Walter and Krantz 1986b; Halliday 2000). As a result of our investigation of mites associated with dung beetles on Bali in 1999, 10 species assigned to three genera of the family Macrochelidae were collected. In the present study, we describe two species of the genus *Macrocheles* as new to science and record seven species of the genera *Macrocheles*, *Glyptholaspis*, and *Neopodocinum* from Bali for the first time.

All the mites studied were collected from ventral surfaces of scarabaeid dung beetles and fixed with 70% ethyl alcohol. Some of the specimens were dissected

under a stereoscopic microscope after clearing in lactic acid. Each body part was mounted on a slide in Hoyer's medium. Observations and photographs were made with a phase-contrast microscope or a Nomarski differential interference contrast microscope (DIC). Illustrations were prepared with the aid of a drawing tube.

All measurements are given in micrometers ( $\mu\text{m}$ ). Dorsal chaetotaxy follows Halliday (1987). Other terminology, especially the description of sternal ornamentation, follows Walter and Krantz (1986b). Holotypes and some of the paratypes of the species described as new to science will be deposited in the collection of the Museum Zoologicum Bogoriense, Bogor, Indonesia (MZB). Other paratypes will be deposited in the Zoological Collections of the Graduate School of Science, Hokkaido University, Sapporo, Japan (ZIHU). A series of the specimens examined of other species will be deposited in the collection of the Museum Zoologicum Bogoriense, and others will be retained in the first author's private collection.

Family **Macrochelidae** Vitzthum, 1930  
Genus **Macrocheles** Latreille, 1829  
**Macrocheles oigru** Walter and Krantz, 1986

*Macrocheles oigru* Walter and Krantz, 1986b: 281–282, figs 4, 5.

This species was adequately described and illustrated by Walter and Krantz (1986b).

**Material examined.** Two females, Pancasari village, Sukasada district, Buleleng regency, Bali Province, 3 December 1999, G. Takaku and S. Hartini leg., ex *Onitis* sp.; 1 female, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., ex *Aphodiini* sp.; 45 females, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., ex *Onitis* sp.

**Habitat.** This species has been collected from dung beetles *Onitis* spp. (Walter and Krantz 1986b; Takaku 2001).

**Distribution.** *Macrocheles oigru* has been recorded from India, Java, and Sumatra (Walter and Krantz 1986b; Takaku 2001). This is the first record of the species from Bali.

**Macrocheles limue** Samšínák, 1962

*Macrocheles limue* Samšínák, 1962: 202–203, figs 34–36, pls 7, 8.

*Macrocheles eurygaster* Krantz, 1981: 3–7, figs 1–20 [synonymized by Walter and Krantz 1986b].

*Macrocheles limue*: Walter and Krantz 1986b: 283, fig. 3; Roy 1996: 311–314, figs 1–14.

Detailed descriptions of all developmental stages of this species were given by Krantz (1981) under the name of *Macrocheles eurygaster*.

**Material examined.** One female, Pancasari village, Sukasada district, Buleleng regency, Bali Province, 3 December 1999, G. Takaku and S. Hartini leg., ex *Onitis* sp.; 13 females, Bali Barat National Park, Bali Province, other data same as the above; 1 female, Tamblang village, Kubutambahan district, Buleleng regency,

Bali Province, 5 December 1999, G. Takaku and S. Hartini leg., *ex Onitis* sp.

**Habitat.** This species has been collected from the dung beetle genera *Allonitis*, *Aphodius*, *Catharsius*, *Copris*, *Garreta*, *Heliocopris*, *Heteronitis*, *Liatongus*, *Onthophagus*, *Oniticellus*, *Onitis*, and *Scarabaeus* (Samšínák 1962; Walter and Krantz 1986b; Roy 1996; Takaku 2001). This species has also been collected from leaf litter, cow dung, compost, and so on (Roy 1991, 1996).

**Distribution.** *Macrocheles limue* has been recorded from Ethiopia, Chad, Cameroon, Guinea, Zaire, Rwanda, Zambezi, Burundi, Kenya, Uganda, South Africa, Swaziland, India, China, Java, Sumatra, Bali, and Luzon Island in the Philippines (Samšínák 1962; Krantz 1981; Roy 1991, 1996; Walter and Krantz 1986b; Takaku 2001).

### *Macrocheles hallidayi* Walter and Krantz, 1986

*Macrocheles hallidayi* Walter and Krantz, 1986a: 214–216, figs 12, 13.

*Macrocheles hallidayi*: Walter and Krantz 1986b: 289, fig. 1b; Takaku 1998: 30–36, figs 1–14.

The female of this species was adequately described and illustrated by Walter and Krantz (1986a). The male and immature stages were described by Takaku (1998).

*Macrocheles hallidayi* shows remarkable resemblance to *M. aestivus* Halliday, 1986 as Halliday (2000) mentioned. In addition to the similar female characters, males and immatures of these two species appear to be virtually identical (Halliday 2000). The present author (GT) previously stated that dorsal setae j5 and z5 are pilose in the female of *M. aestivus* and smooth in *M. hallidayi*, and that j2 is smooth in *M. aestivus* and pilose in *M. hallidayi* (Takaku 1998; Halliday 2000). In some specimens of *M. hallidayi* collected on Bali, dorsal setae j5 are slightly pilose, while in all the specimens j2 and z5 are pilose and simple, respectively. Although these two nominal species are treated as distinct in the present study because of differences in the form of the dorsal setae, their ecology and distribution in Southeast Asia and Australia should be investigated in more detail, especially in Wallacea.

**Material examined.** Five females, collected from cow dung, Candikuning village, Baturiti district, Tabanan regency, Bali Province, 3 December 1999, G. Takaku and S. Hartini leg.; 36 females, Pancasari village, Sukasada district, Buleleng regency, Bali Province, *ex Onitis* sp., other data same as the above; 1 female, *ex Catharsius* sp., other data same as the above; 43 females, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., *ex Onitis* sp.; 1 female, Tamblang village, Kubutambahan district, Buleleng regency, Bali Province, 5 December 1999, G. Takaku and S. Hartini leg., *ex Onitis* sp.

**Habitat.** This species has been collected from dung beetles *Onitis* spp., *Heliocopris bucephalus* (Fabricius, 1775), and *Catharsius sagax* (Quenstedt, 1806) (Walter and Krantz 1986a; Takaku 1998, 2001).

**Distribution.** *Macrocheles hallidayi* has been recorded from Southeast Asia: India, Thailand, Cambodia, Sarawak, Java, and Sumatra (Walter and Krantz 1986a; Takaku 1998, 2001). This is the first record of the species from Bali.

***Macrocheles krantzi* Evans and Hyatt, 1963**

*Macrocheles krantzi* Evans and Hyatt, 1963: 351, figs 58–61.

*Macrocheles? krantzi*: Krantz and Filipponi 1964: 44, tav. IV, figs 13, 14.

*Macrocheles krantzi*: Wallace 1986: 12, fig. 2E, pl. 2(9); Halliday 2000: 299.

A description and figures of this species were given by Evans and Hyatt (1963), and variations in sternal ornamentation and dorsal setae were documented by Krantz and Filipponi (1964). Halliday (2000) confirmed that the species tentatively identified by Krantz and Filipponi (1964) was *Macrocheles krantzi*.

**Material examined.** One female, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., *ex* Aphodiini sp.; 3 females, *ex* Scarabaeidae sp., other data same as the above; 3 females, *ex* Onitidis sp., other data same as the above; 1 female, Tamblang village, Kubutambahan district, Buleleng regency, Bali Province, 5 December 1999, G. Takaku and S. Hartini leg., *ex* Onitidis sp.

**Habitat.** This species has been collected from scarabaeid beetle genera *Scarabaeus* and *Onthophagus* (Evans and Hyatt 1963; Krantz and Filipponi 1964; Wallace 1986), and also collected from dung (Roy 1998; Halliday 2000).

**Distribution.** *Macrocheles krantzi* has been recorded from India, Sri Lanka, and Australia (Evans and Hyatt 1963; Krantz and Filipponi 1964). This is the first record of the species from Bali.

***Macrocheles merdarius* (Berlese, 1889)**

*Holostaspis merdarius* Berlese, 1889, fasc. 52(1), fig. 103.

*Macrocheles merdarius*: Sellnick 1940: 27, 86–87, figs 69–71; Evans and Browning 1956: 21–23, figs 24–26, pl. 2, fig. 7; Bregetova and Koroleva 1960: 145–146, figs 106(3), 111, 112(2, 3); Axtell 1963: 628, fig. 6; Filipponi and Pegazzano 1963: 83–88, figs V, VI, tav. XXIV; Karg 1971: 134, 139, figs 148e, 150a; Emberson 1973: 120, pl. 1, fig. 4; Wallace 1986: 9, fig. 2C, pl. 1(4); Hyatt and Emberson 1988: 113–114, fig. 19B–D, pl. 2A; Krantz and Whitaker 1988: 243–244.

A description, figures, and synonymy were published by Filipponi and Pegazzano (1963) in their review of the *M. subbadius* species group.

**Material examined.** One female, Tamblang village, Kubutambahan district, Buleleng regency, Bali Province, 5 December 1999, G. Takaku and S. Hartini leg., *ex* Aphodiini sp.

**Habitat.** The present species has been collected from species of the dung beetle genera *Aphodius*, *Catharsius*, *Copris*, *Coptodactyla*, *Euoniticellus*, *Geotrupes*, *Lepanus*, *Liatongus*, *Notopodaria*, *Onthophagus*, *Pentodon*, *Phanaeus*, and *Synapsidis* (Bregetova and Koroleva 1960; Wallace 1986; Krantz and Whitaker 1988; Masan 1994; Halliday 2000). It has also been recorded from various other beetles (Histeridae, Lucanidae, Silphidae, and Trogidae), mammals (Rodentia), soil, leaf litter, cow dung, compost, manure, and so on (Evans and Browning 1956; Axtell 1963; Costa 1963; Ishikawa 1968; Krauss 1970; Emberson 1973; Krantz and Whitaker 1988; Haitlinger 1991; Halliday 2000).

**Distribution.** *Macrocheles merdarius* has been collected in various regions of the world and is a cosmopolitan species (Wallace 1986; Hyatt and Emberson 1988; Halliday 2000). This is the first record of the species from Bali.

***Macrocheles baliensis* sp. nov.**

(Figs 1–6)

**Description.** *Female.* Length of dorsal shield 424–514 ( $473.6 \pm 21.2$ ); width, 233–277 ( $248.0 \pm 12.8$ ) ( $n=25$ ). Living specimens yellowish brown.

Dorsum (Fig. 1): Dorsal shield oval, entirely or mostly covering idiosoma; surface ornamented with reticulate patterns and punctation; lateral margin of shield smooth; shield with 28 pairs of dorsal setae and 22 pairs of pores; setae j1 slightly pectinate distally; insertions of j1 adjacent or separated; z1 minute, simple, located posterior to level of j2 and broadly separated from insertion of latter; J5 bipectinate; other dorsal setae simple.

Venter (Fig. 2): Tritosternum typical for genus. Sternal shield longer than wide; length 112–129 ( $120.5 \pm 4.0$ ), width at level of coxae II 88–102 ( $95.8 \pm 2.9$ ) ( $n=30$ ); surface ornamented with lines and punctations; anterior half of shield with somewhat reticulate pattern of punctate lines; *linea media transversa* (l.m.t.) distinct and with punctation; posterior half with pair of punctate areas anterior to st3; these punctate areas connected to l.m.t. via faint lines; shield bearing 3 pairs of simple setae and 2 pairs of pores. Metasternal shields oval, each with simple seta and small pore. Epigynial shield triangular, with pair of simple setae and auxiliary sclerites; surface ornamented with lines and punctations. Ventrianal shield pentagonal, ornamented with reticulate or somewhat semi-concentric pattern, and longer than wide; length 139–165 ( $149.5 \pm 7.5$ ), width 124–149 ( $136.2 \pm 5.7$ ) ( $n=30$ ); shield with 3 pairs of preanal setae, pair of paranal setae, and postanal seta; all setae simple; cribrum located posterior to postanal seta. Opisthogastric setae simple. Pair of metapodal shields oblong.

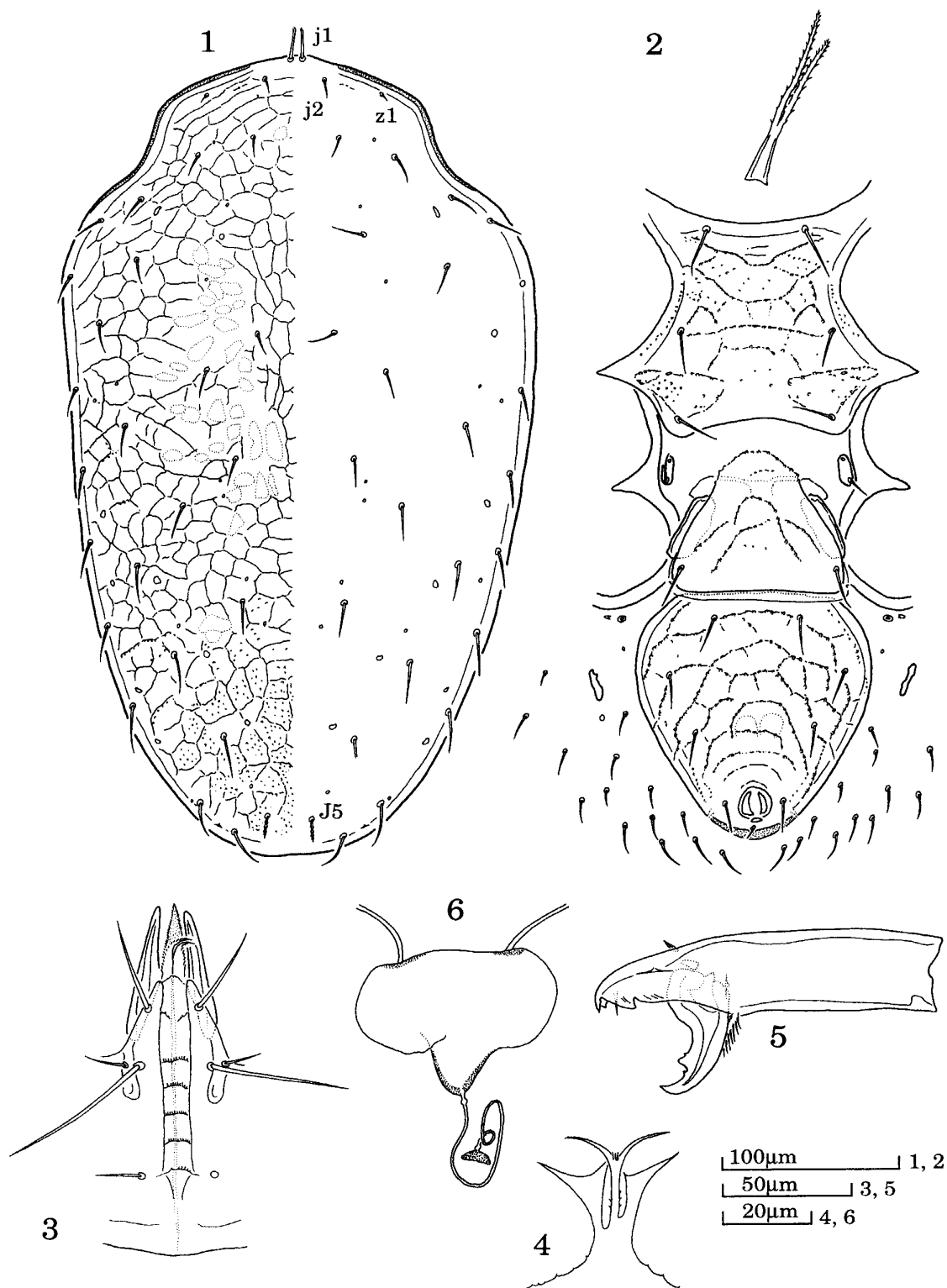
Gnathosoma (Figs 3–5): Well-developed and sclerotized. Deutosternal groove with 4 or 5 rows of denticles. Tectum (Fig. 4) with median process and pair of lateral elements; median process bifurcated and with small spicules laterally and distally; lateral margin serrate. Fixed digit of chelicera (Fig. 5) with simple dorsal seta, robust median tooth, small distal tooth, *pilus dentilis*, and terminal hook; movable digit with bidentate median tooth, minute distal tooth, and terminal hook; arthrodial process strongly pilose; length of fixed digit 124–145 ( $133.4 \pm 5.4$ ), length of movable digit 45–53 ( $49.6 \pm 2.0$ ) ( $n=20$ ). Other features typical for genus.

Legs: Tarsus I without ambulacrum and claw; tarsi II–IV with developed ambulacra and claws. Most leg segments with only simple setae, except for femora I, II, and IV and genu II with simple setae and slightly pilose setae. Leg chaetotaxy typical for genus; genu IV with 6 setae. Leg length (except ambulacrum,  $n=30$ ): leg I, 322–396 ( $369.6 \pm 17.6$ ); leg II, 310–379 ( $343.0 \pm 14.8$ ); leg III, 265–306 ( $286.2 \pm 11.2$ ); leg IV, 371–420 ( $389.6 \pm 14.5$ ).

Sacculus foemineus (Fig. 6): Pair of sacculi fused broadly; cornu rounded distally and sclerotized; spermatheca hemispherical.

*Male and other stages.* Unknown.

**Type series.** Holotype: female (MZB.Acar.2232a), Bali Barat National Park,



Figs 1–6. *Macrocheles baliensis* sp. nov., female, holotype. 1, dorsal shield, various dorsal setae labeled; 2, venter; 3, ventral view of gnathosoma; 4, tectum; 5, chelicera; 6, *sacculus foemineus* (paratype, ZIHU2026).

Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., *ex* Aphodiini sp. Paratypes: 9 females (ZIHU2017–2025), other data same as for holotype; 17 females (MZB.Acar.2232b.1–2232b.14, ZIHU2026–2028), *ex* Onitis sp., other data same as for holotype; 3 females (ZIHU2029–2031), Tamblang village, Kubutambahan district, Buleleng regency, Bali Province, 5 December 1999, G. Takaku and S. Hartini leg., *ex* Aphodiini sp.

**Etymology.** The specific name is derived from the type locality.

**Remarks.** The present species is similar to *Macrocheles rhodesi* Evans and Hyatt, 1963, recorded from Northeastern and Southern Rhodesia and South Africa, in dorsal chaetotaxy and sternal ornamentation. However, *Macrocheles baliensis* sp. nov. is distinguished from *M. rhodesi* by the following female characteristics (corresponding conditions of *M. rhodesi* in parentheses on the bases of the holotype and the original description by Evans and Hyatt (1963)): 1) length of dorsal shield less than 600  $\mu\text{m}$  (about 700  $\mu\text{m}$  long); 2) dorsal setae z1 located posterior to level of j2 and broadly separated from insertion of latter (located anterior to level of j2 and close to insertion of latter); and 3) anterior half of sternal shield with reticulate ornamentation of punctate lines (with faint trace of punctate ornamentation, but no reticulate pattern).

The present species also resembles *Macrocheles scarabae* Vishnupriya and Mohanasundaram, 1988, recorded from India, in sternal ornamentation, but it differs from the latter in the following characteristics of the female (corresponding conditions of *M. scarabae* in parentheses cited from the original description by Vishnupriya and Mohanasundaram (1988)): 1) dorsal shield with 28 pairs of dorsal setae (31 pairs); 2) dorsal setae short and not reaching insertions of setae behind them (some opisthonotal setae reaching insertions of setae behind them); 3) sternal shield with 3 pairs of sternal setae (4 pairs).

The above-mentioned *M. scarabae* Vishnupriya and Mohanasundaram, 1988 is a senior homonym of *M. scarabae* Chinniah and Mohanasundaram, 1995 (Vishnupriya and Mohanasundaram 1988; Chinniah and Mohanasundaram 1995). We could not receive any response concerning the type specimens of those two species from India. We now propose the name *Macrocheles arabaesc* **nom. nov.** as a replacement name for *Macrocheles scarabae* Chinniah and Mohanasundaram, 1995. The specific name “*arabaesc*” is an anagram of “*scarabae*”, to be regarded as a noun in apposition.

### *Macrocheles monticola* sp. nov.

(Figs 7–13)

**Description.** *Female.* Length of dorsal shield 996–1085 ( $1042.3 \pm 36.4$ ); width, 636–653 ( $648.8 \pm 8.5$ ) ( $n=4$ ). Living specimens reddish brown.

Dorsum (Fig. 7): Dorsal shield oval, entirely covering idiosoma; surface ornamented with reticulate pattern and punctation; lateral margin of shield smooth; shield with 28 pairs of dorsal setae and 22 pairs of pores; setae j1 slightly pectinate distally or simple; insertions of j1 separated; z1 minute, simple, and located anterior to level of j2; Z4 and S4 slightly pectinate distally or simple; Z5 and S5 bipectinate distally; J5 bipectinate entirely or along distal half; other dorsal setae simple.

Venter (Figs 8, 9): Tritosternum typical for genus. Length of sternal shield al-

most same as its width; length 200–204 ( $201.0 \pm 2.0$ ), width at level of coxae II 204–212 ( $206.0 \pm 4.0$ ) ( $n=4$ ); surface of sternal shield ornamented with lines and punctation; anterior half of shield with lightly punctate *linea oblique anteriores* (l.o.a.); area between paired l.o.a. ornamented with faint lines; l.m.t. distinct and with small punctations; *linea oblique posteriores* (l.o.p.) distinct and adjacent or fused to l.m.t. (Figs 8, 9); shield bearing 3 pairs of simple setae and 2 pairs of pores. Metasternal shields oval, each with simple seta and small pore. Epigynial shield triangular, with pair of simple setae and auxiliary sclerites; surface ornamented with faint lines and small punctations. Ventrianal shield subtriangular, ornamented with somewhat semi-concentric pattern, longer than wide; length 379–404 ( $390.8 \pm 10.4$ ), width 310–335 ( $322.3.2 \pm 10.7$ ) ( $n=4$ ); shield with 3 pairs of preanal setae, pair of paranal setae, and postanal seta; all setae simple; cribrum located posterior to postanal seta. Opisthogastric setae simple or slightly pectinate distally. Pair of metapodal shields rectangular.

Gnathosoma (Figs 10–12): Well-developed and sclerotized. Deutosternal groove with 5 rows of denticles. Tectum (Fig. 11) with median process and pair of lateral elements; median process bifurcated and with spicules laterally; lateral margin serrate. Fixed digit of chelicera (Fig. 12) with simple dorsal seta, robust median tooth, small distal tooth, *pilus dentilis*, and terminal hook; movable digit with bidentate median tooth, minute distal tooth, and terminal hook; arthrodial process strongly pilose; length of fixed digit 257–261 ( $259.7 \pm 2.3$ ), length of movable digit 104–106 ( $104.7 \pm 1.2$ ) ( $n=3$ ). Other features typical for genus.

Legs: Tarsus I without ambulacrum and claw; tarsi II–IV with developed ambulacra and claws. Most leg segments with only simple setae, except for femora III and IV, genu IV, tibia IV, and tarsus IV with simple setae and slightly pectinate setae. Leg chaetotaxy typical for genus; genu IV with 6 setae. Leg length (except ambulacrum,  $n=4$ ): leg I, 816–873 ( $844.5 \pm 23.6$ ); leg II, 889–955 ( $916.0 \pm 29.5$ ); leg III, 906–938 ( $914.0 \pm 16.0$ ); leg IV, 1248–1281 ( $12256.3 \pm 16.5$ ).

Sacculus foemineus (Fig. 13): Pair of globular sacculi present; cornu rounded distally and sclerotized; spermatheca oblong.

*Male and other stages.* Unknown.

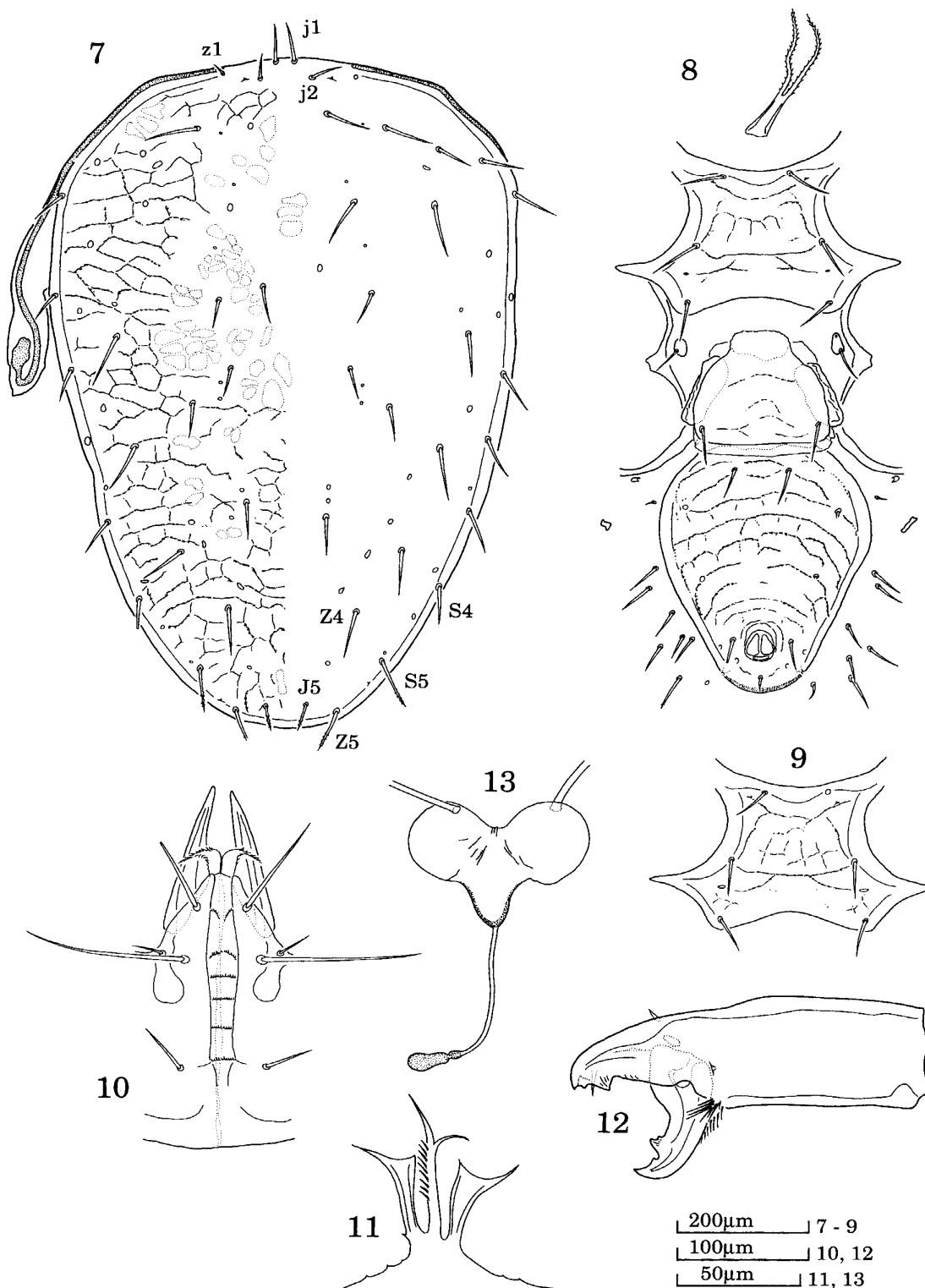
**Type series.** Holotype: female (MZB.Acar.2233a), Pancasari village, Sukasada district, Buleleng regency, Bali Province, 3 December 1999, G. Takaku and S. Hartini leg., *ex Catharsius* sp. Paratypes: 3 females (MZB.Acar.2233b, ZIHU2032–2033), other data same as for holotype.

**Etymology.** The specific name refers to the habitat of the present species, which could be collected only in highland area over 1000 m above sea level.

**Remarks.** *Macrocheles monticola* is similar to *M. transversus* Evans and Hyatt, 1963, recorded from Uganda and South Africa, in dorsal chaetotaxy and sternal ornamentation, but it differs from the latter by the following characteristics of the female (corresponding conditions of *M. transversus* in parentheses on the bases of the paratype (BM1961.7.14.240) and the original description by Evans and Hyatt (1963)): 1) dorsal shield ornamented with irregular reticulation and punctation (ornamented with conspicuous transverse reticulation); 2) length of sternal shield almost same as its width (sternal shield wider than long); and 3) anterior half of sternal shield ornamented with l.o.a. and faint lines (ornamented with conspicuous reticulation).

The present species also resembles to *Macrocheles coprephorae* Chinniah and





Figs 7–13. *Macrocheles monticola* sp. nov., female, holotype. 7, dorsal shield, various dorsal setae labeled; 8, venter; 9, sternal shield (paratype, ZIHU2033); 10, ventral view of gnathosoma; 11, tectum; 12, chelicera; 13, *sacculus foemineus*.

Mohanasundaram, 1995, recorded from India, in body size, dorsal chaetotaxy, and sternal ornamentation, but it differs from the latter by the following characteristics of the female (corresponding conditions of *M. coprephorae* in parentheses cited from the original description by Chinniah and Mohanasundaram (1995)): 1) some dorsal setae, e.g. S5 and Z5, bipectinate distally (all setae simple and acicular); 2) ventrianal shield with 3 pairs of preanal setae (only 2 pairs).

Genus *Glyptholaspis* Filipponi and Pegazzano, 1960

*Glyptholaspis fimicola* (Sellnick, 1931)

*Gamasus tardus*: Berlese 1882: 108, figs 5, 9a, b [*non* C. L. Koch, 1841].

*Holostaspis marginatus*: Berlese 1889, fasc. 52(4–5) [*non* Hermann, 1804].

*Nothrolaspis fimicola* Sellnick, 1931: 765, figs 52, 53c, f.

*Macrocheles plumiventris*: Evans and Browning 1956: 38 [only male].

*Glyptholaspis fimicola*: Filipponi and Pegazzano 1960: 139–147, figs 1, 2, tav. III, IV; Hyatt and Emberson 1988: 117–118, pl. 5E.

A detailed description, figures, and synonymy were given by Filipponi and Pegazzano (1960).

**Material examined.** One female, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., *ex Onitis* sp.

**Habitat.** This species has been collected from scarabaeid beetles, cow dung, compost, manure, and so on (Hyatt 1956; Filipponi and Pegazzano 1960; Krantz 1970; Hyatt and Emberson 1988).

**Distribution.** *Glyptholaspis fimicola* has been recorded from England, Iceland, Italy, Greece, China, India, South Africa, Congo, and North America (Sellnick 1931, 1940; Filipponi and Pegazzano 1960; Yin *et al.* 1964; Krantz 1970; Cicolani 1983; Hyatt and Emberson 1988; Roy 1989). This is the first record of the species from Southeast Asia and Indonesia.

Genus *Neopodocinum* Oudemans, 1902

*Neopodocinum jaspersi* (Oudemans, 1900)

*Laelaps jaspersi* Oudemans, 1900: 72.

*Neopodocinum jaspersi*: Oudemans 1902: 25–26, figs 31–33; Oudemans 1904: 119–120, pl. 6, figs 18–20; Krantz 1965: 176–179, figs 32–38, pl. IV, figs 34–37, pl. V, figs 38–39.

This species was redescribed and illustrated by Krantz (1965). The present material agrees with his description except for variation in the number of rows of denticles in the deutosternal groove. Although most of our material has five rows of denticles, some individuals have six.

*Neopodocinum jaspersi* is similar to *N. javensis* Krantz, 1965, but it is distinguished from the latter by the following characters (corresponding conditions of *N. javensis* in parentheses): 1) tips of dorsal setae j4 not extending beyond insertions of j5 (extending beyond insertions of j5); 2) l.m.t. incomplete, and paired lateral ex-

tensions of l.m.t. distinctly separated medially (virtually meeting medially); 3) deutosternal groove with 5 or 6 rows of denticles (only 4 rows of denticles).

**Material examined.** One female, Bali Barat National Park, Bali Province, 4 December 1999, G. Takaku and S. Hartini leg., *ex Onthophagus* sp.; 3 females, 1 male, and 5 deutonymphs, *ex Onitis* sp., other data same as the above; 1 deutonymph, *ex Copriini* sp., other data same as the above.

**Habitat.** This species has been collected from specimens of the scarabaeid beetle genera *Heliocopris* and *Copris* (Krantz 1965).

**Distribution.** *Neopodocinum jaspersi* has been recorded from the Netherlands, China, India, and Java (Krantz 1965; Li and Chang 1979). This is the first record of the species from Bali.

***Neopodocinum spirostris* (Berlese, 1910)**

(Figs 14–35, 38–46)

*Megalolaelaps spirostris* Berlese, 1910: 258.

*Megalolaelaps spirostris*: Bregetova 1958: 176 [as a junior subjective synonym of *N. nederveeni* Oudemans, 1903].

*Neopodocinum spirostris*: Krantz 1965: 191–193, figs 57–59.

*Neopodocinum spirostris* was originally described by Berlese (1910) under the genus *Megalolaelaps*, and his description was adopted in Krantz's (1965) review of the genus. However, the descriptions of the dorsal shield and other parts of the adults were insufficient, and immature stages have not been described yet. Here we redescribe the adult female and male and describe the immatures of this species on the basis of the materials collected in Bali.

**Description.** *Female.* Length of dorsal shield 905–955 ( $932.8 \pm 22.5$ ); width, 661–710 ( $683.8 \pm 15.9$ ) ( $n=6$ ). Living specimens reddish brown.

Dorsum (Fig. 14): Dorsal shield oval, attenuated posteriorly, and surrounded by unsclerotized integument laterally and posteriorly; surface without ornamentation, but with short flap over most setal insertions; lateral margin of shield smooth or slightly crenulate; shield with 31 pairs of dorsal setae and 20 pairs of pores; unpaired seta (Jx) absent; setae j1 short and simple; z1 short and pectinate; J5 minute and simple; most setae pectinate, except for simple z5 and J2; anterior setae long, reaching or surpassing insertions of setae behind them, e.g. setae j2, j3, and z2; setae j5 located posterior to level of z5; paired J2 close together; J3 located anterior to level of Z3. Unsclerotized integument with many simple or pectinate setae.

Venter (Fig. 15): Tritosternum well developed and with pilose laciniae. Sternal shield wider than long; length 78–90 ( $84.7 \pm 4.8$ ), width at level of coxae II 257–277 ( $263.7 \pm 9.0$ ) ( $n=6$ ); surface of shield ornamented with slight reticulation; l.m.t. distinct and complete; shield with 3 pairs of simple setae and 2 pairs of pores; all setae long and surpassing insertions of setae behind them. Metasternal shields oval, each with simple seta and small pore. Surface of epigynial shield with faint lines; shield with pair of simple setae and auxiliary sclerites. Anal shield oval and longer than wide; length 155–171 ( $161.0 \pm 6.1$ ), width 102–110 ( $107.3 \pm 3.3$ ) ( $n=6$ ); shield with pair of paranal setae and 1 postanal seta; all setae simple; cribrum located on lateral margin of anal shield, its anterior extensions surpassing level of paranal

setae. Opisthogaster bearing more than 40 pairs of simple or pectinate setae; pair of thin, oblong plates located in area posterior to coxae IV. Peritrematic shield narrowly developed, with short posterior extension and large lateral fossa; posterior end of peritreme slightly curved; anterior extremities extending to laterad of setae z1.

Gnathosoma (Figs 16–18, 38): Well-developed and sclerotized. Deutosternal groove with 5 rows of denticles; 3 pairs of hypostomal setae and pair of palpcoxal setae present; internal posterior hypostomal setae thick and conical, and with fine tip in some specimens (Fig. 38); other setae simple, and external posterior hypostomal setae thicker than other 2 paired setae. Palpal chaetotaxy of trochanter, femur, and genu 2-5-6. Palptarsus with trifurcate apotele. Tectum (Fig. 17) unipartite and with many small spines laterally and dorsally; base serrate laterally. Fixed digit of chelicera (Fig. 18) with simple dorsal seta, robust median tooth, small distal tooth, *pilus dentilis*, and terminal hook; movable digit with median blunt-tipped tooth and terminal hook; arthrodial process strongly pilose; length of fixed digit 277–286 ( $283.2 \pm 3.6$ ), length of movable digit 114–122 ( $119.3 \pm 3.3$ ) ( $n=6$ ).

Legs (Fig. 42): Tarsus I with ambulacrum and minute paired structures like small claws; tarsi II–IV with well developed ambulacra and claws (Fig. 42). Most leg segments with simple and pectinate setae, except for coxae I–IV, trochanters III and IV, and femora III and IV with only simple setae. Coxa I and trochanter II each with ventral ridge, and coxae II with 3 ventral ridges. Leg chaetotaxy typical for genus; trochanter III with 4 setae; genu IV with 7 setae and its chaetotaxy 1, 2/1, 2/0, 1. Leg length (except ambulacrum,  $n=6$ ): leg I, 645–710 ( $671.8 \pm 22.2$ ); leg II, 653–677 ( $663.7 \pm 9.7$ ); leg III, 702–726 ( $716.7 \pm 9.4$ ); leg IV, 873–971 ( $926.2 \pm 33.0$ ).

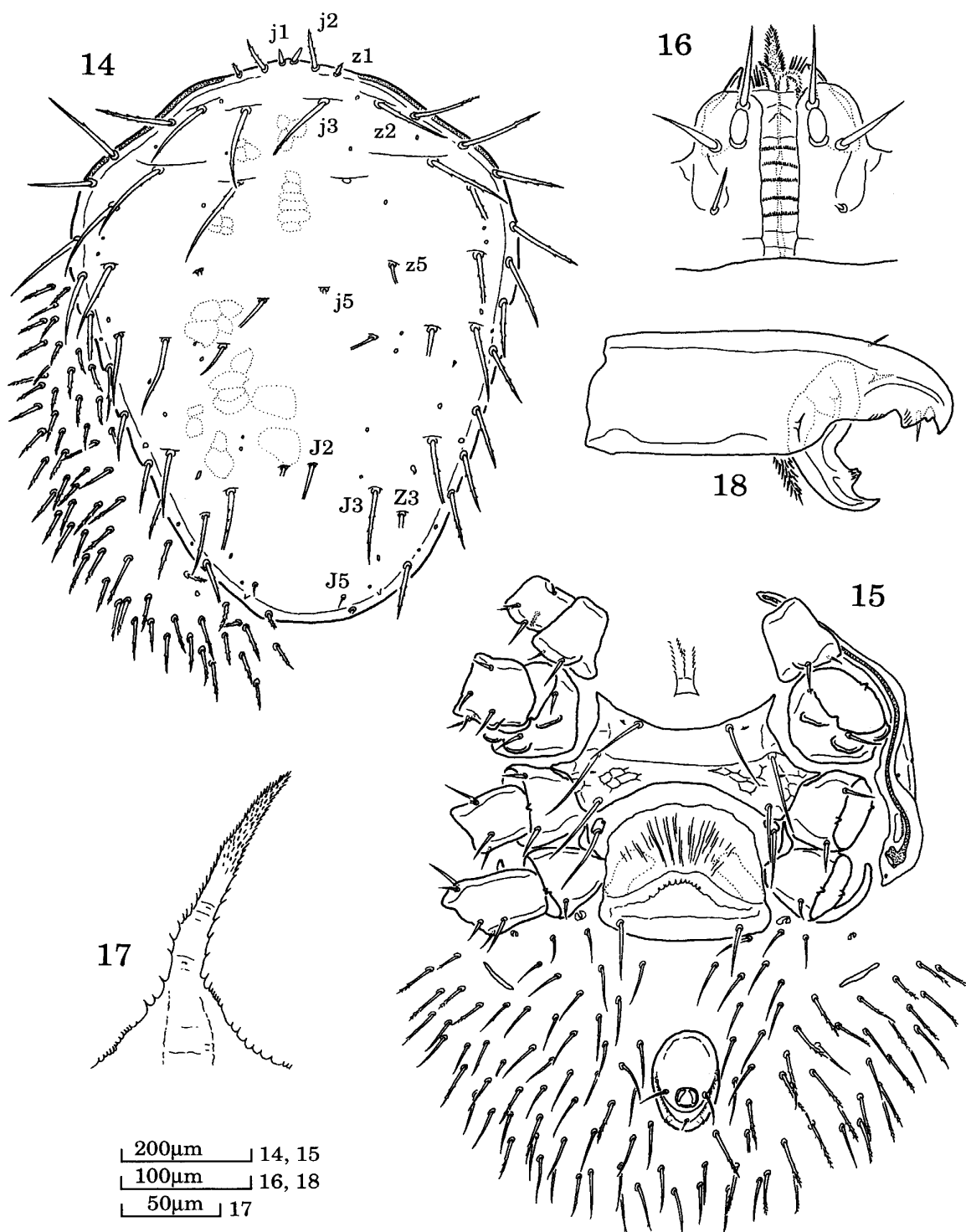
Sacculus foemineus: Unknown.

*Male*. Length of dorsal shield 996–1126 ( $1070.8 \pm 49.3$ ); width, 734–832 ( $780.0 \pm 41.8$ ) ( $n=5$ ). Living specimens reddish brown.

Dorsum (Fig. 19): Dorsal shield similar to that of female, with 31 pairs of dorsal setae and 20 or 21 pairs of pores; unpaired or paired additional setae (Jx) present near J2 in some specimens; setae j1 short and simple; z1 short and pectinate; J5 minute and simple; most setae pectinate, but j6, z5, z6, and J2 simple in some specimens; anterior setae long, reaching or surpassing insertions of setae behind them; setae j5 located at or posterior to level of z5; paired J2 adjacent to each other; J3 located posterior to level of Z3. Unsclerotized integument with many simple or pectinate setae.

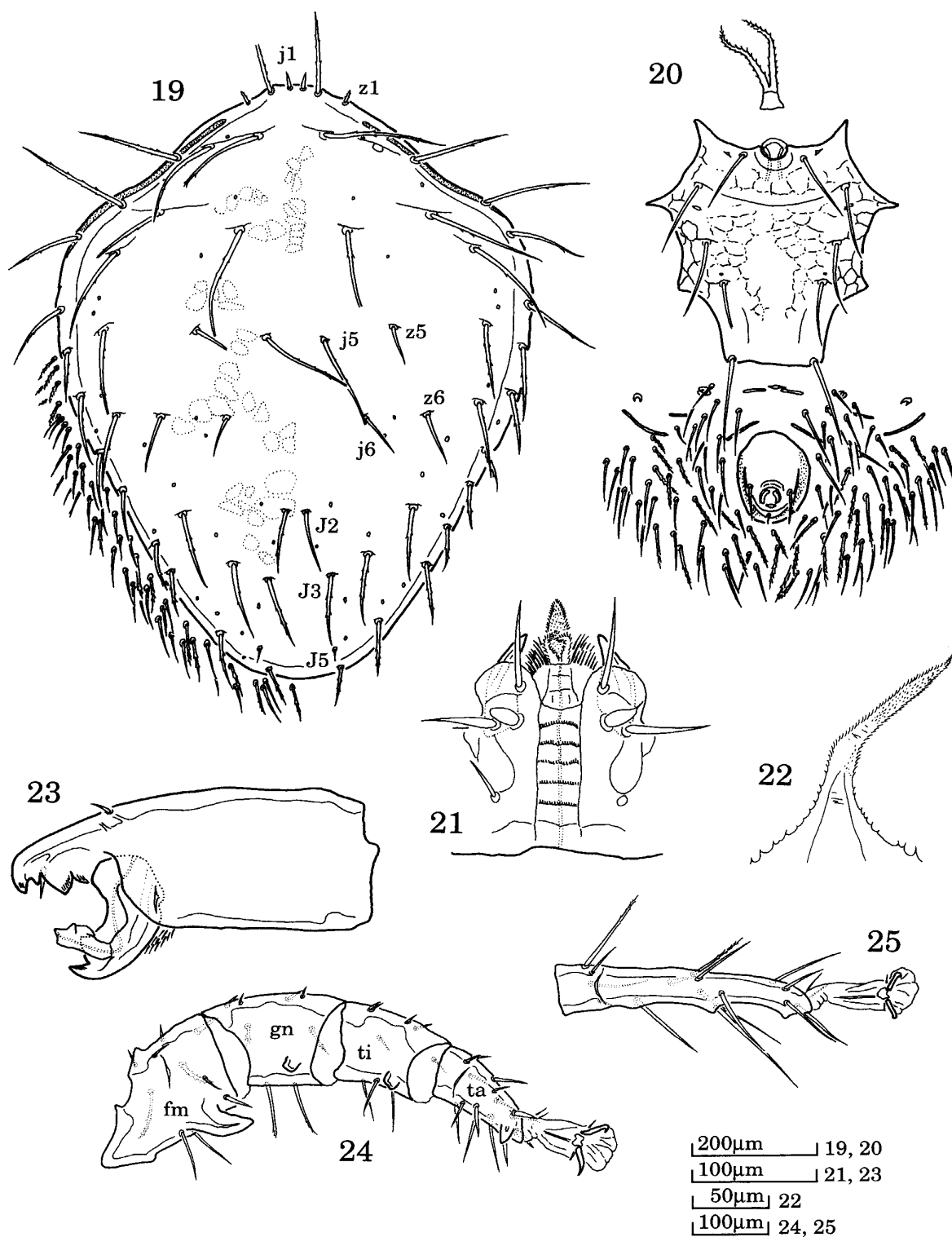
Venter (Fig. 20): Tritosternum as in female. Sternoventral shield longer than wide; length 347–388 ( $369.0 \pm 17.8$ ), width at level of coxae II 237–245 ( $240.2 \pm 3.3$ ) ( $n=5$ ); surface of shield ornamented with slight reticulation; l.m.t. distinct and complete; shield with 5 pairs of simple setae and 3 pairs of pores; most setae long and reaching or surpassing insertions of setae behind them. Anal shield oval and longer than wide; length 155–171 ( $160.6 \pm 6.7$ ), width 110–118 ( $114.8 \pm 3.3$ ) ( $n=5$ ); shield with pair of paranal setae and 1 postanal seta; all setae simple; cribrum located on lateral margin of anal shield, its anterior extensions surpassing level of paranal setae. Opisthogaster bearing more than 40 pairs of simple or pectinate setae; 7 to 9 thin, oblong plates present between sternoventral and anal shields. Peritrematic shield and peritreme as in female.

Gnathosoma (Figs 21–23, 39): Well-developed and sclerotized. Deutosternal groove with 5 rows of denticles; 3 pairs of hypostomal setae and pair of palpcoxal

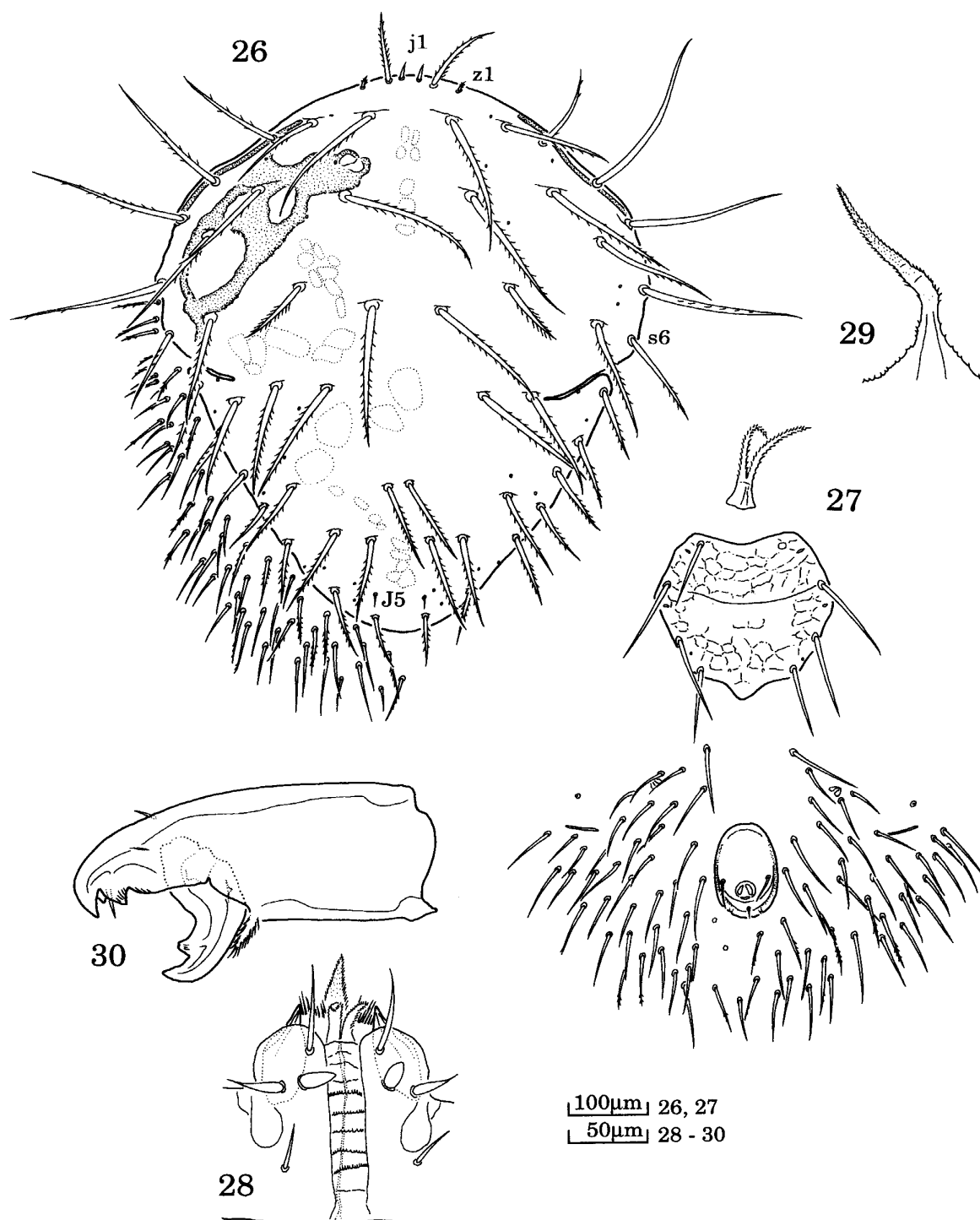


Figs 14–18. *Neopodocinum spirostris* (Berlese, 1910), female. 14, dorsum, various dorsal setae labeled; 15, venter; 16, ventral view of gnathosoma; 17, tectum; 18, chelicera.

setae present; internal posterior hypostomal setae thick and conical, and with fine tip in some specimens (Figs 21, 39); other setae simple, and external posterior hypostomal setae thicker than other 2 paired setae. Palpal chaetotaxy of trochanter,

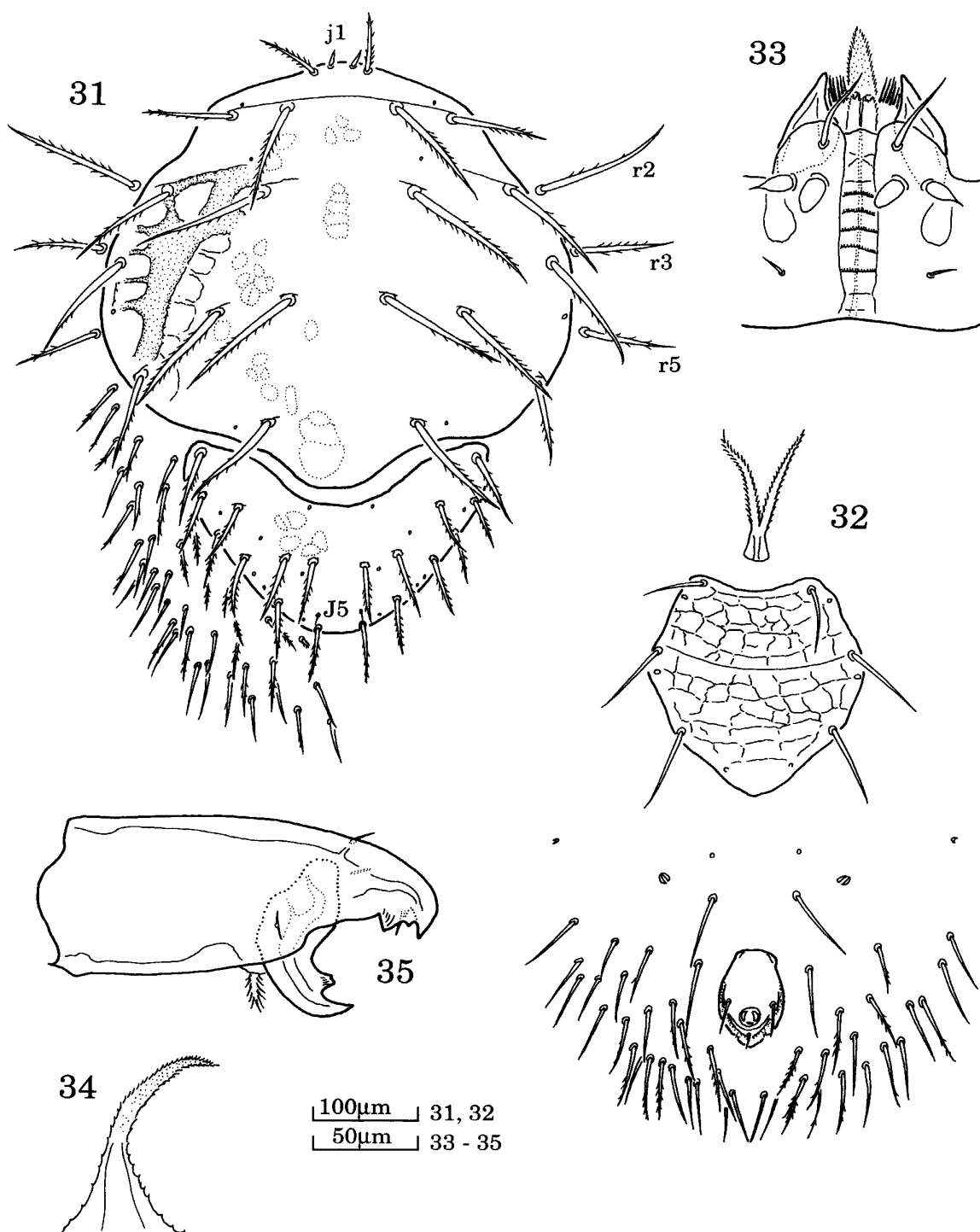


Figs 19-25. *Neopodocinum spinirostris* (Berlese, 1910), male. 19, dorsum, various dorsal setae labeled; 20, venter; 21, ventral view of gnathosoma; 22, tectum; 23, chelicera; 24, leg II except for coxa and trochanter (fm, femur; gn, genu; ta, tarsus; ti, tibia); 25, tarsus IV.



Figs 26-30. *Neopodocinum spirostris* (Berlese, 1910), deutonymph. 26, dorsum, various dorsal setae labeled; 27, venter; 28, ventral view of gnathosoma; 29, tectum; 30, chelicera.

femur, and genu 2-5-6. Palptarsus with trifurcate apotele. Tectum (Fig. 22) unipartite and with many small spines laterally and dorsally; base serrate laterally. Fixed digit of chelicera (Fig. 23) with simple dorsal seta, robust median tooth, small distal tooth, *pilus dentilis*, and terminal hook; movable digit with median tooth, sper-

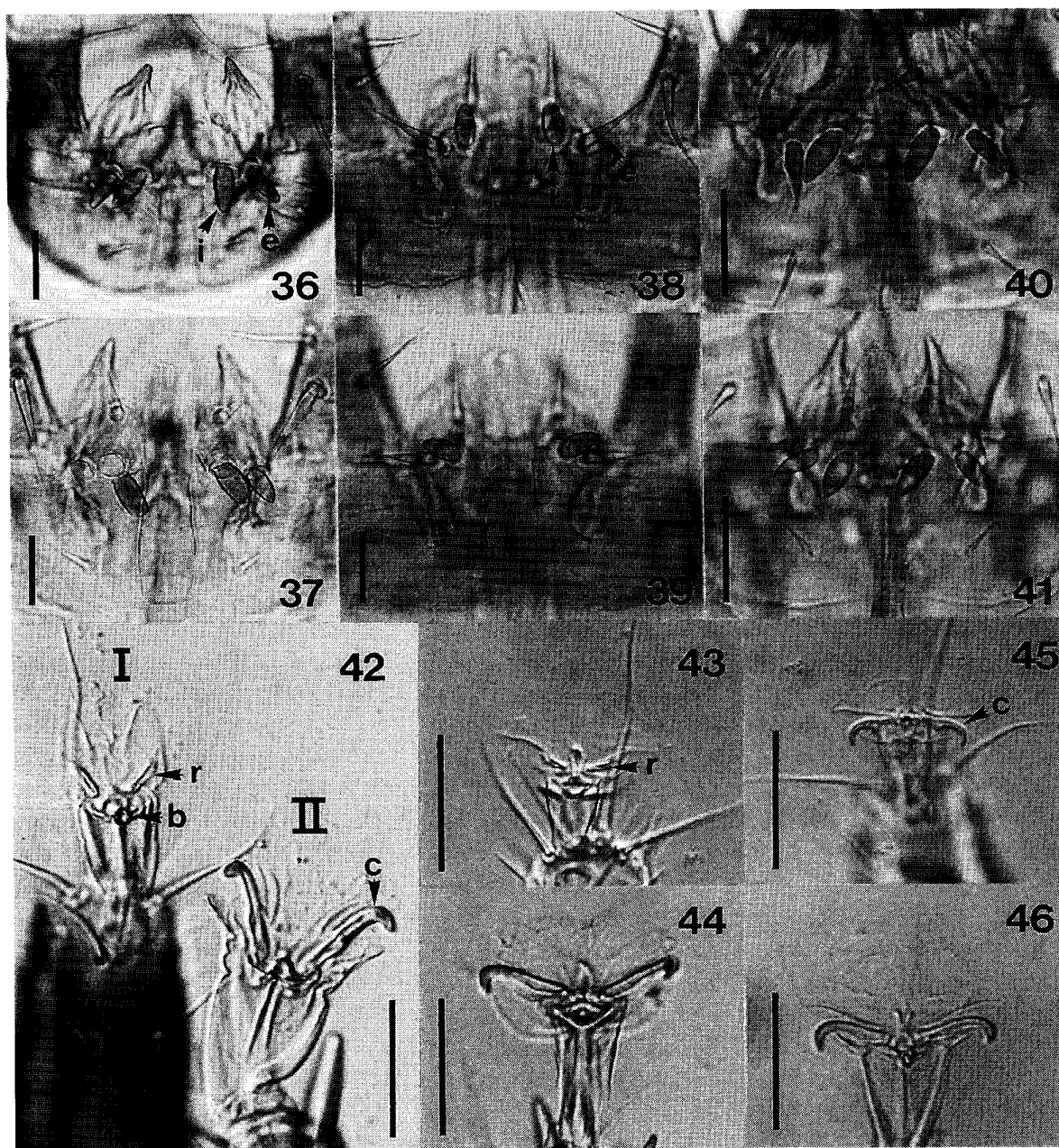


Figs 31–35. *Neopodocinum spinirostris* (Berlese, 1910), protonymph. 31, dorsum, various dorsal setae labeled; 32, venter; 33, ventral view of gnathosoma; 34, tectum; 35, chelicera.

matodactyl, and terminal hook; spermatodactyl short and with cleft; arthrodial process strongly pilose; length of fixed digit 286–306 ( $290.0 \pm 8.9$ ), length of movable digit 110–118 ( $113.2 \pm 3.3$ ) ( $n=5$ ).

Legs (Figs 24–25): Tarsus I with ambulacrum and minute paired structures like





Figs 36–46. *Neopodocinum vanderhammeni* Krantz, 1965 (36, 37) and *N. spinirostris* (Berlese, 1910) (38–46), DIC microphotographs. 36–41, hypostome: 36, paratype female; 37, paratype male; 38, female; 39, male; 40, deutonymph; 41, protonymph. 42–46, pretarsi I (42, 43, 45) and II (42, 44, 46): 42, female; 43, 44, deutonymph; 45, 46, protonymph. Scale bars=50  $\mu$ m. Abbreviations: I, leg I; II, leg II; b, basilar sclerite; c, claws; e, external posterior hypostomal setae; i, internal posterior hypostomal setae; r, remnant of claws.

small claws; tarsi II–IV with well developed ambulacra and claws (as in Fig. 42). Most leg segments with simple and pectinate setae, except for coxae I–IV, trochanters III and IV, and femur IV with only simple setae. Coxa I and trochanter II each with posteroventral ridge; coxa II with 1 or 2 posterior ridges; femur, genu,

and tibia II each with anteroventral spur; proximoventral aspect of femur II modified to spur; distal end of tarsus II with spur (Fig. 24); tarsus IV with distal spur and 1 or 2 medioventral protuberances (Fig. 25). Leg chaetotaxy as in female. Leg length (except ambulacrum,  $n=5$ ): leg I, 808–824 ( $814.4 \pm 6.7$ ); leg II, 792–849 ( $829.2 \pm 24.8$ ); leg III, 840–922 ( $899.2 \pm 34.0$ ); leg IV, 1167–1314 ( $1243.8 \pm 64.7$ ).

*Deutonymph.* Length of dorsal shield 718–734 ( $728.7 \pm 9.2$ ); width, 547–612 ( $585.0 \pm 33.9$ ) ( $n=3$ ). Living specimens reddish or yellowish brown.

Dorsum (Fig. 26): Dorsal shield attenuated posteriorly, ornamented with ridges anterolaterally, and with lateral incisions behind dorsal setae s6; shield bearing 31 pairs of dorsal setae; j1 short and simple; z1 short and pectinate; J5 minute and simple; most setae strongly pectinate. Unsclerotized integument with many simple or pectinate setae.

Venter (Fig. 27): Tritosternum as in female. Sternoventral shield peltate, wider than long; length 204–212 ( $208.0 \pm 4.0$ ), width at level of second sternal pore 216–224 ( $220.0 \pm 4.0$ ) ( $n=3$ ); surface of shield ornamented with faint reticulation; l.m.t. complete; with 4 pairs of simple setae and 3 pairs of pores; all setae long and surpassing insertions of setae behind them. Anal shield oval and longer than wide; length 122–135 ( $126.3 \pm 7.5$ ), width 69–82 ( $74.0 \pm 7.0$ ) ( $n=3$ ); shield with pair of paranal setae and 1 postanal seta; all setae simple; cribrum located on lateral margin of anal shield, its anterior extensions surpassing level of paranal setae. Opisthogaster bearing more than 30 pairs of simple or pectinate setae; pair of thin, oblong plates present behind coxae IV, but occasionally absent. Development of peritrematic shield weak and without posterior extension; peritreme as in female.

Gnathosoma (Figs 28–30, 40): Well-developed and sclerotized. Deutosternal groove with 5 rows of denticles; 3 pairs of hypostomal setae and pair of palpcoxal setae present; internal posterior hypostomal setae thick and conical, and with fine tip in some specimens; external posterior hypostomal setae similar to internal posterior hypostomal setae, but former more attenuate and thinner than latter (Figs 28, 40); other setae simple. Palpal chaetotaxy of trochanter, femur, and genu 2-5-6. Palptarsus with trifurcate apotele. Tectum (Fig. 29) unipartite and with many small spines laterally and dorsally; base serrate laterally. Fixed digit of chelicera (Fig. 30) with simple dorsal seta, robust median tooth, small distal tooth, *pilus denticilis*, and terminal hook; movable digit with blunt-tipped median tooth and terminal hook; arthrodial process strongly pilose; length of fixed digit 224–228, length of movable digit 94 ( $n=2$ ).

Legs (Figs 43, 44): Tarsus I with ambulacrum and minute paired structures like small claws (Fig. 43); tarsi II–IV with well developed ambulacra and claws (Fig. 44). Most leg segments with simple and pectinate setae, except for coxae I–IV, trochanters III and IV, femora III and IV, and tarsus III with only simple setae. Coxa I and trochanter II each with posteroventral ridge; coxa II with 3 ventral ridges. Leg chaetotaxy as in female. Leg length (except ambulacrum,  $n=3$ ): leg I, 571–628 ( $601.0 \pm 28.6$ ); leg II, 563–628 ( $595.7 \pm 32.5$ ); leg III, 628–677 ( $650.0 \pm 24.9$ ); leg IV, 783–873 ( $816.0 \pm 49.6$ ).

*Protonymph.* Length of idiosoma 539–710 ( $613.5 \pm 62.2$ ); width, 416–465 ( $441.8 \pm 22.8$ ) ( $n=6$ ). Length of podonotal shield 400–432 ( $418.3 \pm 9.2$ ); width, 416–465 ( $438.1 \pm 18.8$ ) ( $n=7$ ). Length of opisthonotal shield 114–126 ( $122.0 \pm 5.7$ ); width, 282–306 ( $288.9 \pm 8.6$ ) ( $n=7$ ). Living specimens yellowish brown.

Dorsum (Fig. 31): Podonotal shield convex posteriorly and ornamented with

ridges anterolaterally; shield bearing 11 pairs of dorsal setae; setae j1 short and simple; other podonotal setae strongly pectinate. Opisthonotal shield concave anteriorly, with 10 pairs of setae; setae J5 simple and minute; other opisthonotal setae strongly pectinate. Integumental setae simple or pectinate; setae r2, r3, and r5 longer than other integumental setae.

Venter (Fig. 32): Tritosternum as in female. Sternoventral shield peltate; length of shield similar to its width; length 188–204 ( $195.4 \pm 6.3$ ), width at level of second sternal pore 184–204 ( $193.7 \pm 6.0$ ) ( $n=7$ ); surface of shield ornamented with faint reticulation; l.m.t. distinct and complete; shield bearing 3 pairs of simple setae and 2 pairs of pores. Anal shield oval and longer than wide; length 88–106 ( $98.6 \pm 6.5$ ), width 57–65 ( $62.4 \pm 3.0$ ) ( $n=7$ ); shield with pair of paranal setae and 1 postanal seta; all setae simple; cribrum located on lateral margin of anal shield, its anterior extensions surpassing level of paranal setae. Opisthogaster bearing more than 20 pairs of simple or pectinate setae; plates absent. Peritrematic shield and peritreme greatly reduced, located between coxae III and IV.

Gnathosoma (Figs 33–35, 41): Well-developed and sclerotized. Deutosternal groove with 5 rows of denticles; 3 pairs of hypostomal setae and pair of palpcoxal setae present; internal posterior hypostomal setae thick and conical, and with fine tip in some specimens; external posterior hypostomal setae similar in shape and length to internal posterior hypostomal setae, but former attenuate or with fine tip distally; other setae simple (Figs 33, 41). Palpal chaetotaxy of trochanter, femur, and genu 1-4-5. Palptarsus with trifurcate apotele. Tectum (Fig. 34) unipartite and with many small spines laterally and dorsally; base serrate laterally. Fixed digit of chelicera (Fig. 35) with simple dorsal seta, robust median tooth, small distal tooth, *pilus dentilis*, and terminal hook; movable digit with blunt-tipped median tooth and terminal hook; arthrodial process pilose; length of fixed digit 167–184 ( $177.7 \pm 6.0$ ), length of movable digit 73–80 ( $75.7 \pm 2.8$ ) ( $n=2$ ).

Legs (Figs 45, 46): Tarsus I with ambulacrum and paired small claws (Fig. 45); tarsi II–IV with developed ambulacra and claws (Fig. 46). Most leg segments with simple and pectinate setae, except for coxae I–IV, trochanters III and IV, femur IV, and tarsus III with only simple setae. Coxa I with posteroventral ridge; coxa II with 3 ventral ridges. Leg chaetotaxy typical for protonymphs of this genus; trochanter III with 4 setae; genu IV with 5 setae and its chaetotaxy 1, 2/0, 2/0, 0. Leg length (except ambulacrum,  $n=7$ ): leg I, 441–514 ( $480.1 \pm 24.6$ ); leg II, 441–547 ( $488.4 \pm 34.5$ ); leg III, 430–547 ( $499.7 \pm 40.9$ ); leg IV, 588–661 ( $628.4 \pm 30.3$ ).

*Larva*. Unknown.

**Material examined.** Six females, 4 males, 2 deutonymphs, and 4 protonymphs, Pancasari village, Sukasada district, Buleleng regency, Bali Province, 3 December 1999, G. Takaku and S. Hartini leg., *ex Catharsius* sp. (Scarabaeidae); 1 male, 1 deutonymph, and 3 protonymphs, Bakungan, Bali, other data same as the above.

**Habitat.** This species has been collected previously from *Copris* sp. (Berlese 1910).

**Distribution.** *Neopodocinum spinirostris* has been recorded from Java (Berlese 1910; Krantz 1965). This is the first record of the species from Bali.

**Remarks.** *Neopodocinum spinirostris* is remarkably similar to *N. vanderhammeni* Krantz, 1965 as Krantz (1965) mentioned. In adult and immature stages, the ornamentation and condition of the dorsal shield, the dorsal chaetotaxy, the l.m.t.

of the sternal shield, and the internal posterior hypostomal setae of the two species show remarkable congruence, but *N. spinirostris* is distinguished from *N. vanderhammeni* by the following characters (corresponding conditions of *N. vanderhammeni* in parentheses): 1) external posterior hypostomal setae attenuate and thinner than internal posterior hypostomal setae in female and male as in Figs 38, 39 (both setae rounded distally and approximately equal in dimensions as in Figs 36, 37); and 2) tarsus I without claws in deutonymph (with a pair of claws).

The pattern of development of claws in the serial stages of the present species is different from those of its congeners. In species in which adults develop an ambulacrum on tarsus I, the deutonymph and protonymph possess distinct claws on tarsus I (Krantz 1965). In this species, however, distinct claws appear in only the protonymph, and other stages lack distinct claws. This condition has been recorded otherwise only in the closely related species, *N. dehongense* Li and Chang, 1979 (Li and Chang 1979; Li and Gu 1987).

The ambulacra of tarsi I in adults and deutonymphs possess paired structures that seem to be remnants of claws (Figs 42, 43). In the present material, these structures are located lateral to the basilar sclerite of the ambulacra, and they are also observable in the adult paratypes of *N. vanderhammeni*. The position and shape of the structures suggest that they may be homologues of the claws found in the protonymph.

*Neopodocinum spinirostris* is also very similar to *N. dehongense* Li and Chang, 1979 recorded from Yunnan Province, China. Judging from the description and illustration provided by Li and Chang (1979), the only difference between these two species is the number of opisthogastric setae: more than 40 pairs in *N. spinirostris*, but only about 30 pairs in *N. dehongense*. Although this difference may be no more than variation, and there is a possibility that *N. dehongensis* is a junior synonym of *N. spinirostris*, we tentatively treat them as separate species because we have not seen the type specimens of *N. dehongense*.

In Bregetova (1958), *N. spinirostris* was treated as a junior synonym of *N. nederveeni* Oudemans, 1903 recorded from Sumatra [Bregetova (1958) assigned those two species to the genus *Megalolaelaps*]. These two nominal species are very similar to each other in dorsal setation and in having numerous opisthogastric setae. However, judging from the gnathosoma of *N. nederveeni* as illustrated by Oudemans (1904), the internal posterior hypostomal seta is not thick and short-conical, but simple and long. Because of this clear difference in gnathosomal structure, we treat above two species as separate species in the present study.

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## References

- Axtell, R. C. 1963. Acarina occurring in domestic animal manure. *Annals of the Entomological Society of America* 56: 628–633.
- Berlese, A. 1882. Il polimorfismo e la partenogenesi di alcuni Acari (Gamasidi). *Bollettino della Societa Entomologica Italiana* 14: 88–141.
- Berlese, A. 1889. *Acari Myriopoda et Scorpiones Hucusque in Italia Reperta*. 52 (1, 4, 5). Padova.
- Berlese, A. 1905. Acari nuovi. Manipulus IV. *Redia* 2: 154–176.
- Berlese, A. 1910. Lista di nuove specie e nuovi generi di Acari. *Redia* 6: 242–271.
- Berlese, A. 1911. Acarorum species novae quindecim. *Redia* 7: 429–435.
- Berlese, A. 1921. Centuria quinta di Acari nuovi. *Redia* 14: 143–195.
- Bregetova, N. G. 1958. A new species of gamasid mite of the genus *Megalolaelaps* (Parasitiformes, Gamasoidea). *Parazitologicheskii Sbornik* 18: 176–179. [In Russian with English summary]
- Bregetova, N. G. and Koroleva, E. V. 1960. The macrochelid mites (Gamasoidea, Macrochelidae) in the USSR. *Parazitologicheskii Sbornik* 19: 32–154. [In Russian with English summary]
- Chinniah, C. and Mohanasundaram, M. 1995. Five new species of *Macrocheles* (Macrochelidae: Acari) associated with scarabaeid beetles (Scarabaeidae: Coleoptera) from Tamil Nadu, India. *Entomon* 20: 215–221.
- Cicolani, B. 1983. Remarks on some macrochelid mites from Greece. *Biologia Gallo Hellenica* 10: 171–176.
- Costa, M. 1963. The mesostigmatic mites associated with *Copris hispanus* (L.) (Coleoptera, Scarabaeidae) in Israel. *Journal of the Linnean Society (Zoology)* 45: 25–45.
- Emberson, R. M. 1973. Macrochelid mites in N. Z. (Acarina: Mesostigmata: Macrochelidae). *New Zealand Entomologist* 5: 118–127.
- Evans, G. O. and Browning, E. 1956. British mites of the subfamily Macrochelinae Trägårdh (Gamasina-Macrochelidae). *Bulletin of the British Museum (Natural History), Zoology* 4: 1–55.
- Evans, G. O. and Hyatt, K. H. 1963. Mites of the genus *Macrocheles* Latr. (Mesostigmata) associated with coprid beetles in the collections of the British Museum (Natural History). *Bulletin of the British Museum (Natural History), Zoology* 9: 327–401.
- Filipponi, A. and Pegazzano, F. 1960. Acari del genere *Glyptholaspis* nom. nov. pro *Macrocheles* (*Macrocheles*) Berl., 1918 (Mesostigmata, Macrochelidae). *Redia* 45: 133–171.
- Filipponi, A. and Pegazzano, F. 1963. Specie italiane del gruppo-subbadius (Acarina, Mesostigmata, Macrochelidae). *Redia* 48: 69–91.
- Haitlinger, R. 1991. List of mites occurring on insects in Poland. *Wiadomości Parazytologiczne* 37: 85–90.
- Halliday, R. B. 1986. Mites of the *Macrocheles glaber* group in Australia (Acarina: Macrochelidae). *Australian Journal of Zoology* 34: 733–752.
- Halliday, R. B. 1987. Further observations on the dorsal idiosomal chaetotaxy in the Macrochelidae (Acarina). *International Journal of Acarology* 13: 51–53.
- Halliday, R. B. 2000. The Australian species of *Macrocheles* (Acarina: Macrochelidae). *Inverte-*

- brate Taxonomy 14: 273–326.
- Hermann, J. F. 1804. *Mémoire Apterologique*. Frédéric-Louis Hammer, Strasbourg, 144 pp. [Not seen]
- Hyatt, K. H. 1956. A collection of mites from stable manure. *Entomologist's Monthly Magazine* 92: 36–38.
- Hyatt, K. H. and Emberson, R. M. 1988. A review of the Macrochelidae (Acari: Mesostigmata) of the British Isles. *Bulletin of the British Museum (Natural History), Zoology* 54: 63–125.
- Ishikawa, K. 1968. Studies on the mesostigmatid mites associated with the insects in Japan (I). *Reports of Research Matsuyama Shinonome Junior College* 3: 197–218.
- Karg, W. 1971. Acari (Acarina), Milben. Unterordnung Anactinochaeta (Parasitiformes). Die freilebenden Gamasina (Gamasides), Raubmilben. *Die Tierwelt Deutschland* 59: 1–475.
- Koch, C. L. 1841. *Deutschlands Crustaceen, Myriapoden und Arachniden*. Vol. 31–34. Regensburg. [Not seen]
- Krantz, G. W. 1965. A review of the genus *Neopodocinum* Oudemans, 1902 (Acarina, Macrochelidae). *Acarologia* 7: 139–226.
- Krantz, G. W. 1967. A review of the genus *Holostaspella* Berlese, 1904 (Acarina: Macrochelidae). *Acarologia* 9 (supplement): 91–146.
- Krantz, G. W. 1970. Acari (Mesostigmata): Macrochelidae. *South African Animal Life* 14: 19–23.
- Krantz, G. W. 1981. Two new *glaber* group species of *Macrocheles* (Acari: Macrochelidae) from Southern Africa. *International Journal of Acarology* 7: 3–16.
- Krantz, G. W. and Filipponi, A. 1964. Acari della famiglia Macrochelidae (Mesostigmata) nella collezione del South Australian Museum. *Rivista di Parassitologia* 25: 35–54.
- Krantz, G. W. and Whitaker, Jr., J. O. 1988. Mites of the genus *Macrocheles* (Acari: Macrochelidae) associated with small mammals in North America. *Acarologia* 29: 225–259.
- Krauss, W. 1970. Die europäischen Arten der Gattungen *Macrocheles* Latreille 1829 und *Geholaspis* Berlese 1918. *Acarologie, Schriftenreihe für Vergleichende Milbenkunde* 14: 1–43.
- Latreille, P. A. 1829. Les Arachnides (Arachnides). Pp. 206–291. In: Cuvier, G. (Ed.) *Le Règne Animal*. Second edition, Vol. 4. Déterville, Paris.
- Li, C.-c. and Chang, N.-k. 1979. A new species and a new record of the genus *Neopodocinum* Oudemans from China (Acarina: Macrochelidae). *Acta Entomologica Sinica* 22: 357–360.
- Li, C.-c. and Gu, Y.-m. 1987. Notes on the genus *Neopodocinum* in China, with descriptions of two new species (Acarina, Macrochelidae). *Entomotaxonomia* 9: 133–140.
- Masan, P. 1994. The mesostigmatic mites (Acarina, Mesostigmata) associated with the dung beetles (Coleoptera, Scarabaeidae) in South Slovakia. *Biologia, Bratislava* 49: 201–205.
- Oudemans, A. C. 1900. Verslag van de 55ste Zomervergadering der Nederlandsche Entomologische Vereeniging, te Oosterbeek, op 9 Juni 1900. *Tijdschrift voor Entomologie* 43: 72. [Not seen]
- Oudemans, A. C. 1902. New list of Dutch Acari. Second part. *Tijdschrift voor Entomologie* 45: 1–52.
- Oudemans, A. C. 1903. Acarologische Aanteekeningen, VIII. *Entomologische Berichten* 1: 100–103.
- Oudemans, A. C. 1904. Notes on Acari. XIIIth series. *Tijdschrift voor Entomologie* 47: 114–135.
- Roy, R. K. 1989. Indian species of the genus *Glyphtholaspis* (Acari: Macrochelidae) with description of two new species. Pp. 343–353. In: Channabasavanna, G. P. and Viraktamath, C. A. (Eds) *Progress in Acarology*, Vol. 1. E. J. Brill, Leiden, 523 pp.
- Roy, R. K. 1991. A catalogue of the soil mesostigmatid mites (Acari) collected from Palni Hills and Western Ghats, Southern India. Pp. 749–753. In: Veeresh, G. K., Rajagopal, D. and Vi-

- raktamath, C. A. (Eds) *Advances in Management and Conservation of Soil Fauna*. Oxford & IBH, New Delhi, 925 pp.
- Roy, R. K. 1996. Redescription of *Macrocheles limue* Samšínák (Acarina: Macrochelidae). *Journal of the Bombay Natural History Society* 93: 311–314.
- Roy, R. K. 1998. The genus *Macrocheles* Latreille (Acarina: Macrochelidae) in India: morphological variations and geographical distribution. *Journal of the Bombay Natural History Society* 95: 295–300.
- Samšínák, K. 1962. Neue entomophile Acari aus China. *Acta Societatis Entomologicae Cechosloveniae* 59: 186–204.
- Sellnick, M. 1931. Zoologische Forschungsreise nach den Jonischen Inseln und dem Peloponnes. *Sitzungsberichte der Akademie der Wissenschaften in Wien. Mathematisch-Naturwissenschaftlichen Klasse, Abtheilung 1*, 140: 693–776.
- Sellnick, M. 1940. Die Milbenfauna Islands. *Meddelanden från Göteborgs Musei, Zoologiska Advelning* 83: 1–129.
- Takaku, G. 1998. Descriptions of immature stages and male of *Macrocheles hallidayi* Walter and Krantz, 1986 (Acari: Macrochelidae). *Journal of the Acarological Society of Japan* 7: 29–38.
- Takaku, G. 2001. Macrochelid mites (Acari: Macrochelidae: *Macrocheles*, *Holostaspella*) associated with scarabaeid beetles in Sumatra, Indonesia. *Tropics* 10: 497–507.
- Vishnupriya, R. and Mohanasundaram, M. 1988. Mites associated with insects in Tamil Nadu, India. *Entomon* 13: 247–257.
- Vitzthum, H. G. 1925. Fauna Sumatrensis (Beitrag No. 5). Acarinae. *Supplementia Entomologica* 11: 1–79.
- Vitzthum, H. G. 1930. Acarologische Beobachtungen. *Zoologische Jahrbücher, Abteilung für Systematik, Ökologie und Geographie der Tiere* 59: 281–350.
- Vitzthum, H. G. 1931. Résultats scientifiques du voyage aux Indes Orientales Néerlandaises. Acarinen. *Mémoires du Musée Royal d'Histoire Naturelle de Belgique, Hors Série* 3: 1–55.
- Wallace, M. M. H. 1986. Some macrochelid mites (Acari: Macrochelidae) associated with Australian dung beetles (Coleoptera: Scarabaeidae). *Acarologia* 27: 3–15.
- Walter, D. E. and Krantz, G. W. 1986a. Description of the *Macrocheles kraepelini* species complex (Acari: Macrochelidae) with two new species. *Canadian Journal of Zoology* 64: 212–217.
- Walter, D. E. and Krantz, G. W. 1986b. A review of *glaber*-group (s. str.) species of the genus *Macrocheles* (Acari: Macrochelidae), and a discussion of species complexes. *Acarologia* 27: 277–294.
- Yin, S.-k., Cheng, C.-i. and Chang, C.-c. 1964. A preliminary survey of the family Macrochelidae from northeastern China with descriptions of two new species. *Acta Zootaxonomica Sinica* 1: 320–324.